BELL TELEPHONE QUARTERLY

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BELL TELEPHONE QUARTERLY

A Medium of Suggestion and a Record of Progress

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Prosperity

Address by Walter S. Gifford, President, American Telephone and Telegraph Company, before the Chicago Association of Commerce, December 12, 1929.

RECENT events have served to focus public attention to an unusual degree upon the immediate future of business. At such times when perhaps the present is too much with us it seems to me to be helpful to take a long look backward and a long look forward. By doing so we can refresh our minds on the sources of our national wealth and the prospects for continued economic progress in spite of any temporary maladjustments which may momentarily obscure the horizon.

Our country today enjoys an average standard of living far higher than that which obtains in any other country at present, or any country at any time known to history. On what is it based? It is often ascribed to our boundless natural resources. These resources are important but in trying to fashion a true picture it is worth while to remember that all these natural resources were here before the Civil War, and at that time there was no stream of foreign observers landing on our shores to discover the secrets of our prosperity. We had, it is true, made use of the land, cut from the forests, mined coal, iron and precious metals, set up some manufactures and built up a prosperity well beyond that of the colonial period.

The possession of natural resources is not a guarantee of well-being nor prosperity. Natural resources are but tools for man to use to reach the goal of his ambitions. Other nations have had natural resources, but the power and well-being of the nations which stand out in history have rested largely upon tribute from conquered territories. One nation has grown prosperous at the expense of another. Today in this country, the civilization that we are building up is of a differ-

ent sort. It is not dependent upon subjugation of other nations or tribute from them. It is being built upon sounder and more permanent foundations. Its economic objective is as broad as its political objective. Our modern conception is that well-being as well as government shall be of the people, by the people and for the people.

The democratic conception came first in politics, then in education and third in prosperity. A universal participation in government as a practical matter was an American conception. A universal participation in education was likewise first tried in the United States, and a democratic and widespread prosperity is peculiarly an American ambition and American accomplishment. The force and strength of this ideal cannot be overemphasized. A prosperity of the few at the expense of the many is subject always to the danger of attack by the many whether they be inside or outside national boundaries. And what is more serious than this, a prosperity for the few does not invite the energy, resourcefulness and ambitions of the multitude to its support and enlargement. Moreover, this conception of a prosperity for the multitude cannot be based on one man's taking riches from another. It must be and it is based upon a universal effort to create more riches. Fired with this ambition and equipped with the unlimited potentialities of universal education, the American people not only use their natural resources but infinitely multiply their uses.

We are today engaged in a conquest not of men or nations, but of nature. The opportunities for conquest are unlimited, and success is shared by all. Scientific developments, partly evolved by laborious experimentation and scientific research and partly ignited by the spark of inventive genius, are constantly increasing the use of the bounties of nature and making available new products and new services which were not even dreamed of by the generation of our parents. The resources of nature are multiplied by the laboratory of the scientist. The list of the scientific achievements of the present

generation is not only impressive, it is astounding; but men of science tell us that we are on the threshold of even greater achievements, with still further possibilities. Full recognition of the potentialities of this cooperation with nature in which we are engaged is of the utmost importance, for the continued unrelenting prosecution of this kind of nature study makes for continued progress in the welfare and prosperity of our people.

But the possession of unusual natural resources and the increasing scientific knowledge of the forces of nature and of the laws governing the action of these forces do not fully account for the high standard of living enjoyed in this country. Man must not only discover natural laws, but man must adapt scientific discoveries and developments to practical uses if they are to contribute in a material way to our daily comfort and well-being. We might have all the knowledge of nature that we have but without a people of organizing ability and imagination it would not be effectively applied. Men must organize and direct the intricate economic machinery of production and distribution necessary to bring raw materials to the consumer in the form of finished products with the greatest efficiency and the least waste. Man must see to it that the growing wants of the people are satisfied as fully and as economically as possible. Now, the men who came to this country first and those who followed have been, in general, pioneers in temperament—ambitious to achieve and courageous in action. They have been imbued with the vigor and the vision of the true pioneer. They have deliberately broken away from the traditions of the Old World in order to contribute to the fashioning of a new civilization in a land of unfettered opportunity. The admixture of races has produced a population of varied instinctive abilities. A system of universal education has enhanced the native intelligence of this population; while the freedom of our institutions has contributed no small part in maintaining a sense of justice and in developing a widespread spirit of co-operation unhampered by class prejudices.

It is, in my judgment, the character of our man-power and its qualities that have rendered it possible for the United States to make effective to such an extraordinary degree the developments of science.

I should like to illustrate the type of progress made in this country by a brief reference to the telephone industry. The telephone was invented by Dr. Alexander Graham Bell only slightly more than fifty years ago. In the relatively short time which has elapsed since human speech was first transmitted electrically, the telephone business has been so organized and developed here that today practically anybody, anywhere, can talk at any time of the day or night with anybody anywhere else—not only in the United States, but in Mexico, Cuba, Canada, and most of Europe. The ability to render a service of this magnitude rests upon a nation-wide organization, employing over 450,000 American men and women, operating physical properties representing an investment of four billions of dollars which are owned by more than 500,000 stockholders. The progress of the industry has been rapid, steady, and continuous. We shall spend over $700,000,000 in 1930 for plant extensions, additions and betterments.

We are still engaged in making constant improvements in the scope, speed and accuracy of the service, in devising new methods of operation and construction which permit of greater economy; and in our industry, the ultimate limits of progress seem to be as far away as ever. Only a few days ago we inaugurated a new service—telephoning to ships at sea. Insofar as scientific knowledge is concerned, we have already conquered space and time so that it is possible technically to establish instantaneous communication between any two persons anywhere in the world, be either person or both on land, on the sea, or in the air. As a matter of fact, it is already scientifically, but not commercially, practical for each telephone user to see the person with whom he is talking. But greater

scientific knowledge, as I have previously indicated, does not always make a new discovery practicable. We have spent, in the Bell System, some ten or fifteen millions of dollars a year for many years in working out the applications of Bell's fundamental discovery, improving materials, working out new circuits and making infinite changes in switchboards and other apparatus. All of this by itself would not have resulted in the almost instantaneous telephone service that we use every day. Such service is dependent upon not only technical knowledge but upon the effective co-ordination of the work of hundreds of thousands of people widely scattered but each of whom must carry on with an understanding of his or her part in the enterprise.

It is also interesting that the development of the telephone system, and this is true of many other industries, is mostly based on the new understanding of nature, and an effective organization of workers. It isn't dependent on our natural resources. A country poor in natural resources can have a telephone system almost as easily as one with prolific natural resources.

These developments in the telephone industry have been taking place in other industries. New products have been created and old products improved; new wants have been stimulated; and processes and methods have been revamped and revised so that the total physical output per worker has increased tremendously during the past fifty years. Indeed, it is hardly possible to think of an industry which has not, within the last few years, introduced new methods of organization or of manufacture which make the worker more effective in output without increasing the effort he expends.

So long as the scientists succeed in wresting more and more of the secrets of nature from her, and so long as the character and intelligence of our people remain as they are today, we are assured of continued progress to still higher levels of living standards and national prosperity.

Here we are, then, with a democratic conception of prosperity, with an eager, ambitious and inventive population, stimulated by education, with science and the ways and means of applying science constantly being better organized to increase the bounties of nature. It is the character of our people, the institutions they have created, their aims and ideals as well as their energy and inventiveness that are the wherewithals of prosperity.

The doctrine of laissez-faire which was in vogue when this country began its independent career and for many years after is still adhered to in principle by many people in business. Its essence was that the greatest good to the greatest number is attained by adding together the greatest good which each individual could achieve for himself. It was an extremely individualistic doctrine. Coincident with the organization of big business has come the belief that extreme individualism must be tempered with a regard for social consequences. In some cases big businesses have not gathered this new conception for themselves as rapidly as the public accepted it for them. But the process has gone on very rapidly. The adjustment of big business to democracy, so that it works smoothly, efficiently, and to the end of widespread prosperity, gives ample scope to the energies and abilities of our people. We could greatly increase our prosperity and stabilize it, if we made but such reasonable strides as we ought to expect in this field of human relations. It is perhaps a moral and ethical field, yet results in it are as surely translatable into economic progress as are the discoveries of pure science.

In the days of laissez-faire, if a new process threw people out of work, they were merely the victims of progress. At present this process is called technological unemployment and there is an increasing disposition on the part of the public to expect industry to make these transitions as easy on the individuals concerned as possible, as well as to improve the processes of industry as a whole—and business accepts this responsibility.

Readjustment is the price of progress. Of course, with a civilization which involves intricate machinery and interdependent relationships, the result of given tendencies is not always obvious until too late to prevent some temporary hardship on the part of small groups of our population. By and large, however, the hazards of readjustment are avoidable. Such stumbling as we may witness along the road of progress will be due not to acts of God, but to the failure of man.

It is becoming more and more generally recognized that business has a distinct responsibility in providing that the economic readjustments demanded by industrial progress are effected with the greatest possible ease. Readjustment should not be allowed to generate maladjustment. This Chicago Association of Commerce, which was organized twenty-five years ago, is a splendid example of the earnest desire and endeavor of American business men to co-operate for the advancement of the community in which they live and hence for the advancement of the nation as a whole. In recent years its interests have been many and varied, but its activities have all been forward-looking and designed to aid and direct local progress. Other groups of men in other cities, as well as groups associated in national organizations, have been working along similar lines. The results of these group efforts cannot be other than highly beneficial. With the greater understanding of the problems of readjustment that has been developed in recent years, and will increase in the years to come, there is certainly a sound basis for hope that our stumblings in the future will be more infrequent and less important. The progress of business is in the hands of you and your fellow business men. Yours is the responsibility to derive from business and industry the greatest possible beneficence.

Opportunistic speculation in the hope of quick profit, such as we have very recently witnessed, must more and more give way to systematic planning for the assurance of permanent gain. This is equally true of individuals and of business en-

terprises. In business organizations already the autocratic "captain of industry" has largely been superseded by a type of management which recognizes that its responsibility is three-fold—that in fact, if not in law, it is a trustee acting in the joint interests of owners, workers and customers. Recognition of this responsibility must lead to the wider practice of constructive planning based not upon a restricted view of the possibilities of the moment, but upon the vision presented by a long look ahead. If I may refer again to the telephone business, a number of years ago we inaugurated a systematic scheme for formulating fairly definite programs covering a period of five years into the future. These programs are necessarily subject to modification from time to time; but we have found that the practice of looking at least five years ahead has resulted in much more stable and economical progress than otherwise could have been possible. Other industries, I know, have also been taking similar steps to plan for the long pull; indeed, the growth in the number of large business organizations is playing a large part in making such planning feasible. "Planned progress" will not only facilitate the anticipation of coming readjustments, but will tend to minimize such temporary fluctuations in the steady rate of business expansion as may still occur.

So far as I am aware, there is no organic law which has prevented other nations from making the same rate of industrial progress as has the United States. That we have made such rapid progress and they have not is, in my judgment, due in large part to the temperament, the genius and the ideals of the people in this country. At the same time, many of our foreign friends and some of those in academic circles within our own borders are openly critical of certain elements involved in our industrial development. These criticisms usually overemphasize the materialistic aspects of our civilization and underestimate its human and idealistic values. This is sometimes called a mechanized nation, the implication being that we are becom-

ing a people of machine-tenders—mere automatons whose individualities are submerged under the passion for standardization. Such a conception, in my opinion, is distorted in the extreme. Nowhere in the world is there a more progressive and more skilled body of workers than in this country. Nowhere in the world does the worker need to be more alert and observing. Nowhere in the world does the worker have as much opportunity for material advancement, for mental development, for recreation and bodily exercise. So far as the comforts of life are concerned, perhaps nowhere in the world is there less standardization than here. It is, of course, true that large scale industrial operations have demanded the output of large volumes of products which are uniform in character; but limitations upon styles and varieties have been no more than those dictated by common sense and total output of all products has been so large and distribution of these products so well organized that the effective range of consumers' choice remains exceedingly wide. I, for one, am certainly not prepared to concede that the urban or rural consumer in this country has, as a practical matter, a more restricted choice as to what he buys—whether it be a motor car or a pair of shoes—than the corresponding consumer in any other country. It may perhaps be that in our industrial progress we have not devoted sufficient attention to the difficult art of living as distinguished from the simpler art of making a living, but what people of any nation can as a whole give great heed to cultural development unless and until they are free from the slavery of economic want? Regardless of momentary disturbances, this freedom has been very generally acquired, and acquired once and for all, in the United States.

Under these conditions the civilization which is being developed in conjunction with our progress along the road to higher standards and greater prosperity will be one which will afford our people the fullest opportunity to become richer in cultural values as well as in material goods. Worship of the

almighty dollar as an end in itself is distinctly on the decline, if it ever widely existed. Already mere money-making on the part of the individual is receiving less and less recognition as a measure of success in life. Already the approbation of business is turning more and more toward those leaders who are wise and constructive rather than ruthless and greedy opportunists who seek to build fortunes without regard to the ultimate consequences affecting the public welfare. Indeed, it is this changing tendency in sentiment which inspires me with absolute faith that our progress in the future will be even more brilliant than in the past.

Any dispassionate review of the trends of American economic life cannot fail to make clear to all who are not willfully blind that the foundations of our present day standards are sound and enduring. The profession of business is rightfully attaining a respected place among other professions contributing to a well-rounded civilization. At the same time grave responsibility rests upon you members of this Chicago Association of Commerce, for it is you and others like you throughout the country upon whom falls the duty of directing business and community affairs so that every one will be afforded the fullest opportunity of making the most out of life. Finally, let us realize at all times that unless the temper and the genius of our people are suddenly changed, unless their aspirations and perceptions are suddenly dulled, continued improvement in the standard of living and in the general welfare of this country is as inevitable as the tides of the ocean.

The sensational break in stock prices has recently engaged the attention of every one. While this break has made it clear that the future progress of the United States cannot be discounted in the market to such an extent that any one period should unduly profit, it is my judgment that for those who are willing to do their part in producing that progress there has never been a place or time which offered such assurances as the United States does at present.

With an unusual abundance of natural resources, with a genius for invention and widespread organization for exhaustive, scientific research resulting as it does in a continual conquest of nature, with a people ambitious to achieve—universally educated, free from class prejudices, and possessing unusual ability for practical organization, with a conception of government looking toward the well-being of all, with almost unbelievable developments in the way of new and more economical processes going forward in almost every industry, with science and the best methods of business organization being more generally adopted in the conduct of agriculture, with an improving recognition by management of its wider responsibilities and a growing recognition on the part of business of its possibilities for the public good—prosperity is not something to be adversely affected for an appreciable period of time by any of the maladjustments which temporarily beset the path of our orderly progress.

The facts speak for themselves and their logical results cannot and will not be altered except by a change in the character of the people of this country. We can, in my judgment, face the future with a confidence that not only will our standard of living become higher and higher so far as material needs and comforts are concerned, but that upon the foundation of this higher standard of material conditions will arise a spiritual and cultural development which will give our children and our children's children the priceless heritage of a finer civilization.

Communication Facilities in the Making

A Personal Impression

DOWN a hundred-foot strip cleared through the North Carolina woods walks a man. One would scarcely associate such a figure, square-jawed and heavy-shouldered, with so childish an occupation as the blowing of soap bubbles. Yet there he trudges, a bucket of soapsuds in his hand, intent on the business of bubble-blowing.

Through this strip of clearing runs a newly constructed telephone cable—a section of the great long distance cable that will eventually connect Washington, and through it Philadelphia, New York and the remainder of the Middle Atlantic and New England states with their sister states in the Southland. The bubble test is about to begin. Each bubble that results from it has its part in assuring the dependability of a new communication link between two important industrial sections of the nation.

As one watches this telephone man, striding along with his pail of soapsuds, and presently climbing a pole, one is watching a nation-wide telephone system in the making. For it is in a multitude of such commonplace operations as this that efficient and dependable telephone service has its genesis.

The soapsud test, which is another name for the gas-pressure test, is only one of many applied, over and over again, to every section of this particular cable, as to all others, as a means of being as certain as is humanly possible that service will be as good as it can be made, and that it will be safeguarded from interruption.

Telephone cables are made up of copper conductors—this particular cable containing 300 pairs—which are insulated from each other with spiral wrappings of paper, the entire bundle of wires being inclosed in a lead-antimony sheath. If

the tiniest of holes appears in this sheath, moisture may eventually work its way into the cable, reach the paper and destroy its insulating properties, short-circuit scores of conductors and interrupt service.

As a means of testing cables for defects in the sheath and for porous joints at the splices, oil-pumped nitrogen or carbon dioxide gas is introduced into the cable under pressure, and careful gauge readings made to determine if any is escaping. If there is such an escape, the defect must be repaired. To be repaired, it must be located—hence the soapsuds. Sometimes a large leak may be detected by the characteristic hissing sound made by the gas as it rushes from the cable. When carbon dioxide is used, it can be located by running the hand along the cable sheath, as the gas is very cold. When, however, neither of these tests proves effective, the sheath must be painted with soapsuds, first at the joints and points near splices where leaks are most likely to occur, then throughout the entire length of the section to be tested. Even the most minute pinhole will be indicated by a bubble.

When millions of dollars are being spent, minutiae assume vast importance. When programs affect the social and economic welfare of wide stretches of territory, there must be no overlooking of pinholes.

A Close-up of a Construction Job

Until one has had an opportunity to obtain what might be termed a "close-up" of a construction job like the building of the cable that is being stretched southward toward Atlanta, as the writer recently did, there are a good many features of the telephone business that must, in the nature of things, remain in the realm of the abstract. An announcement, for instance, that during the past five or six years the Bell System's investment in plant and equipment has increased by about a billion and a half dollars seems little more than a matter of digits and

ciphers. When, however, one has seen telephone facilities in the making, even such impersonal things as construction appropriations are translated into terms of the application of human hands and human minds to a multitude of details.

One can touch such a construction job at almost any point and find somebody grappling with a problem—it may be a group of executives deciding whether a cable shall be built through this particular territory; or an engineering staff weighing the dozens of factors involved in the selection of the specific route the line is to follow; or a foreman and his assistant in consultation over the proper means of carrying out the instructions of blue-print specifications as to the guying of a pole on some particularly troublesome corner.

Blue-prints, by the way, are not popularly supposed to be exactly surcharged with romance and drama. To the average layman, they lack warmth and color. They suggest large-scale production, slide-rule efficiency. And yet, even a blue-print thumbtacked to the wall of an engineering office is not without interest, even to one who is not thoroughly familiar with the technique of telephone construction. With the addition of certain cryptic marks in red and yellow crayon, it tells a fairly detailed story of the progress of the job, step by step, from the obtaining of the right-of-way to the completion of the last splice. And progress—even such progress as is recorded on an engineering chart—is written, first of all, in terms of human effort. There is always drama in the picture of things getting done.

Selection of Route

Every modern toll telephone cable must be provided with repeater stations at intervals of approximately fifty miles. Since it is desirable, from the standpoint of the comfort and convenience of the forces that are to operate these stations, that they be located in or near towns, rather than at isolated points, it is necessary to select a route that will, as nearly

as possible, "spot" these repeater stations advantageously. Consideration must also be given to the necessity of providing the larger and more important towns and cities with long distance facilities through the cable.

Telephone cables are almost entirely immune to damage by sleet storms and similar weather disturbances, but certain conditions are accepted by telephone engineers as definite "hazards" having a bearing on the choice of a route. It is undesirable, for example, to have a cable designed for long distance transmission run close to other electric lines carrying high voltage, because of the interference of the latter, through inductance, with the delicate currents employed in carrying the telephone messages. Railways, which may in the future be electrified or which may adopt high-tension block signalling systems, are accordingly avoided.

Forest lands carrying an especially high degree of fire hazard present another danger, as do buildings too near the cable right-of-way, for the lead sheath is quite easily damaged by a blaze hot enough to melt it. Present or prospective real estate developments are avoided if possible, and unless it is necessary to enter a town to give service, a cable line usually skirts around it.

Expense and difficulty of construction and such problems as the transportation of materials also have their bearing on the choice of route. The solution of each of these separate problems is a phase of the solution of the greater problem of selecting a route that will be as nearly as possible an economical and permanent location.

The route once decided upon, it becomes necessary to obtain the right-of-way and clear it of all standing timber and brush before the actual work of cable construction can begin. In the Carolinas, many portions of the Washington-Atlanta cable run through heavily forested land and in order to afford adequate protection from fire and from falling trees it has been necessary to cut a 100-foot swath through the pine woods.

Some miles behind the gang which clears and brushes the right-of-way comes another to dig the holes and set the poles.

In many sections of the country the use of the earth-boring machine has revolutionized the job of digging pole holes. Such a machine, which is in reality nothing more or less than a huge, motor-driven auger with a bore slightly greater than the diameter of the pole at the butt, can drill a hole to the required depth in a few minutes. On certain portions of the Washington-Atlanta cable, the holes were being dug by hand, this method having been adopted because of the roughness of the country and the relative cheapness of unskilled labor.

Craftsmanship in a Commonplace Job

To classify the digging of telephone pole holes as a task calling for "unskilled" labor does something less than justice to the hole diggers employed in North Carolina. There is considerable knack in efficiently manipulating the long-handled shovels and bars used in digging a five-and-one-half or six-foot hole, and with these men the operation has become almost an art. Some of the holes are "shot" with dynamite to loosen the earth but, even with the aid of explosives, the digging of an average of twelve holes a day per man calls for not a little of craftsmanship in the doing of a commonplace job.

Prosaic though the digging of a hole in the ground may seem, it presents its problems. The assistant gang foreman in charge of the crew of diggers, who is responsible for the "shooting" of the holes, must exercise good judgment, for example, in deciding at each hole to be "shot" whether to use a third of a stick of dynamite, or whether a half a stick will be required. As a simple matter of mathematics, the difference between the two is only one-sixth of a stick and it would not seem greatly important to save so small an amount on each pole. But when poles are to be set every 130 feet along a line extending across half a dozen states, small savings be-

come momentous. Nor does the question of economy end with the savings in explosive. If too much dynamite is used, the earth will be loosened over too great an area and trouble will be experienced in tamping in the pole securely after it is set. Unless poles are properly tamped, it is sometimes necessary to go over the line after a final inspection has been made and straighten and retamp all poles that show a tendency to lean from the perpendicular.

Machines Do the Work of Many Men

The poles are set by derricks, mounted on caterpillar tractors. That is a simple sentence to write, but it tells a whole chapter in the history of telephone construction. What the invention of the power loom was to weaving, a century or more ago, the development of this simple but most efficient device has been to the telegraph, telephone and electric power and lighting industries during the past decade or more.

Before the advent of the pole derrick, poles were raised by sheer muscle-power. Gangs of ten to fifteen men were required for each job, the butt of the pole being laboriously dropped into the hole as the pole was raised with a dozen or more long pikes armed with sharpened steel points which were thrust into its sides. A long, tedious, back-straining job it was, even for a gang that had learned the trick of doing it in the least difficult way.

That an industrial revolution on a small scale has taken place in the telephone business needs no other proof than that which may be had by watching a pole-setting machine, manned by a driver and three men, picking up twenty-five-foot poles and dropping them into their holes at the average rate of something like two and a half minutes to a pole.

As a matter of fact, this application of machinery to the heavy work necessarily involved in cable construction is one of the impressive developments in the communication art during

recent years. It perhaps lacks the spectacular features of such modern marvels as television and transoceanic telephony, but it has been an important factor in making telephone service more economical, more dependable and more efficient for the average telephone user, and particularly for the user of long distance service. It is obvious that modern telephone service would be impossible without the use of cables, and it is almost as obvious that cable construction would be impossible without the Bell System's huge fleet of motor trucks, tractors, motor-driven winches, pole derricks, earth-boring machines and other labor-saving devices.

From the hauling of the heavy reels to the stretching of the suspension strand and the pulling in of cable, machines are lifting burdens from the backs of men. When construction on so gigantic a scale is to be undertaken, no economy of effort must be overlooked. If service is to be provided at a minimum cost, the investment of energy, as well as of capital, must be kept at the lowest possible point.

So that, as one watches a cable construction job in progress —with caterpillar tractors making their way over stumps and rocks and across forest streams, with motors throbbing as winches pull in long stretches of heavy cable, with pole derricks doing their work so easily that it seems almost like child's play—one cannot escape the feeling that here one is watching the making of a telephone service that, at its very beginnings, is being built for economy.

Every Job a Process of Education

But machines can never entirely take the place of men. There still remain a multitude of tasks which require deft hands, long experience, keen judgment—tasks that have to be *learned*. A big construction job like that of building the Washington-Atlanta cable is something more than a job—it is a process of education. It involves an expansion of the forces

normally engaged in the territory where the work is to be done. Some of this expansion may be cared for by the transfer of men from other divisions, but a considerable portion of it must come from the recruiting of new employees.

These new employees must be taught the technique of their respective jobs. Most of them are taken on as helpers and learn the tricks of the trade by experience. Whenever possible, however, a somewhat more formal process of education is provided by the organization of schools in which cable splicing and other branches of the work are taught on a regular schedule.

A rainy day, when it is impossible to undertake some branches of work, and particularly splicing, is quite likely to find an informal school in progress in the storeroom where the construction gang makes its headquarters. One group of initiates will be practicing the art—and art it is—of wiping joints with molten metal, while another will be breaking into the telephone business by making "pig-tail" wire splices. Either job is a tough one for a neophyte.

Take a "lesson" in joint-wiping, for instance. An experienced splicer, talking as he works, first demonstrates the proper technique: scoop up a ladle of melted solder from the metal pot, pour it slowly over the joint, holding a felt-padded "catch-cloth" beneath the joint and wiping the metal as it cools, then smooth off with another padded finishing cloth. That's all there is to it. But for the beginner there's far more to it than that. The melted metal is either too hot or too cold, and ten chances to one the term "catch-cloth" proves a misnomer, for a goodly portion of the smoking solder shows a perverse tendency to run up one's wrist. Never mind—try again, and do it this way this time. Over and over, on many a rainy day, the process is repeated. Some day the helper tries his hand out on the job—on a real splice, made up on a splicer's platform. Sooner or later he is no longer a helper, but a full-fledged splicer.

Or take a class in twisting wire-splices. Three hundred

pairs in a full-sized toll cable, each wire to be paired with its proper mate, twisted securely and soldered, covered with a cotton sleeve, and the entire bundle of conductors boiled out with melted paraffin, wrapped in muslin—that is, roughly, the routine for which the student-splicer must prepare himself. And there's only one way to do each of these separate operations—the right way. As one watches a novice undergoing his course of training, one wonders at the endless variety of wrong ways that may be discovered in trying to do what, to the trained splicer, seems perfectly easy. Ten perfectly good fingers are suddenly and mysteriously transformed into thumbs that get in each other's way.

There was such a beginner in the storeroom at Greensboro, N. C. Rotund, normally of the most light-hearted disposition —a boy who had grown older, but not much older. Seated on an upturned keg, he was taking his turn with the rest at cranking "pig-tails." It was a muggy, sticky day and beads of perspiration stood out on the youngster's forehead as he struggled with his unfamiliar work. With a word of instruction, the splicer who was acting as teacher walked away to supervise another group of helpers.

The student straightened up with an ill-suppressed sigh.

"Well, I'll learn some day," he said, with a rueful attempt at a grin, "and in the meantime I reckon I'll just have to . . . suffer in silence!"

It is thus that telephone men are made—in the patient doing of a succession of little jobs that, once learned, go to make up the big job of providing a nation with a far-flung communication system. It is thus, in smiling "suffering in silence," that there is born the spirit of service that has become a telephone tradition.

One sees a lot of interesting pieces of mechanism in the course of a close-up inspection of such a job as this, and watches a lot of interesting processes. But, after all, machines are less interesting than men; processes are less fascinating

than people. You watch these construction gangs riding out from town in the morning in their great gray trucks, watch them riding back again at night; you see them knitting their brows in the meantime over each problem as it arises, making their decisions and putting these decisions into effect; you see foremen, old hands at the game, going about their business with a word of suggestion here, a word of criticism there and not a few words of encouragement sandwiched in between; you may now and then overhear a full-throated ejaculation of disgust when something goes wrong; you will certainly hear a running fire of good-natured banter, despite the back-straining jobs that everybody expects and accepts as a part of the day's work.

Perhaps you happen on a foreman testing a suspension strand to be sure that it is being hung at the right tension to give the proper sag to the cable. It's a rather interesting operation, to the outsider: throw a handline over the strand, double it, pump it up and down until the strand is oscillating rapidly. Take out a watch and count the oscillations, timing the count for fifteen seconds. Do it again, to be sure the count is correct—maybe repeat the process again and again. Anyway, get it right. Then check the results with a table, worked out by the engineering staff, that shows the required oscillations, and therefore the required tension, for a given length of a given size of strand, at a given temperature.

Somehow this oscillation test strikes you as being a symbol. It strikes you as being something like a composite picture of the whole job—of the whole telephone service, for that matter. You cannot but be aware that, in providing the facilities for a nation-wide telephone service, even seconds assume startling importance; that machinery and manpower alike must operate at exactly the right tension. You realize, as you have perhaps never realized before, that co-ordination and co-operation must be so close that there will be no "sag" in the service when the construction job is done.

Building a telephone system is a big job. But one doesn't begin to understand how big it is until some of its abstractions are made concrete by a close-up view. Its dimensions increase when one examines its details. The importance of America's telephone facilities is magnified when one sees them in the making.

R. T. Barrett.

Operating Features of the Straightforward Trunking Method

ONE of the important factors affecting the problem of handling telephone calls in a multi-office area is the development of suitable operating methods and associated central office equipment so that a call may be completed from one central office to another central office with a minimum amount of error and with the least possible delay. Until recently the plan in most general use under manual operation has been the so-called "call circuit" trunking method.

Call Circuit Trunking

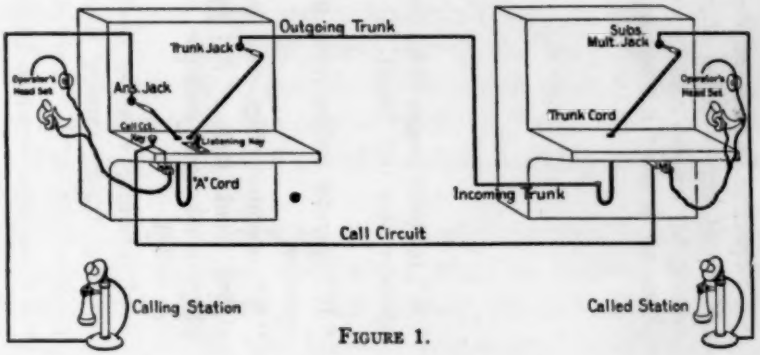


FIGURE 1.

Briefly the call circuit method, as illustrated in Figure 1, may be thus described: Having ascertained from a calling subscriber that a number is desired in another central office the "A" operator connects her telephone set to a talking circuit permanently associated with the telephone set of a "B," or trunk, operator in the particular office where the called subscriber's line terminates. This talking circuit, known as a "call circuit," is used exclusively by the "A" and "B" operators for such conversation as is required in completing calls from originating to terminating offices. The "A" operator,

Essential Steps in Completion of Connections	*Call Circuit*	*Straightforward*
1. Establishing talking circuit from "A" operator to "B" operator.	"A" operator locates and depresses call circuit key to called office connecting her telephone set to the telephone set of the "B" operator.	"A" operator selects idle trunk and plugs cord into trunk jack. "B" operator connected automatically to the selected trunk. A double spurt of tone is sent back over the trunk to indicate to the "A" operator that the "B" operator is connected. The trunk is indicated to the "B" operator by the flashing of the guard signal.
2. Passing order.	"A" operator passes order to "B" operator over call circuit.	"A" operator passes order to "B" operator over trunk in hearing of subscriber.
3. Assigning trunk over which connection is to be established.	"B" operator assigns trunk to "A" operator.	
4. Establishment of trunk connection.	"A" operator plugs cord into assigned trunk jack. "B" operator plugs trunk into multiple jack of line called.	"B" operator plugs trunk into multiple jack of line called.
5. Disconnection.	"A" operator removes cord from outgoing trunk, causing disconnect lamp to light at "B" position. "B" operator removes trunk cord from called line.	"A" operator removes cord from outgoing trunk, causing disconnect lamp to light at "B" position. "B" operator removes trunk cord from called line.

TABLE 1.

after cutting in on the call circuit, repeats the called number to the "B" operator. The "B" operator then tells the "A" operator the number of the particular trunk which she should use for completing the call, after which the "A" operator cuts out from the call circuit and connects the calling subscriber's line to the trunk assigned by the "B" operator. Meanwhile the "B" operator has connected the other end of this trunk to the line of the called party.

Call circuit operation was in successful use for many years in all multi-office cities and the service was of a high order with a relatively small number of operating errors. With this method, however, all the "A" operators in an office have access to the call circuit terminating in a "B" operator's headset with the result that, frequently a number of "A" operators endeavor to pass their orders simultaneously to one "B" operator. This is especially true during the busy hours of the day. Consequently a considerable amount of skill and experience are required on the part of both "A" and "B" operators in order to keep the call circuit method working smoothly and efficiently.

Another plan, known as the "straightforward" method, is also used for handling calls which must be trunked from one central office to another. This method, which follows in fundamental principle the well known "ring down" plan for operating trunks and toll lines, has been rapidly introduced into the multi-office cities throughout the Bell System.

Briefly, the straightforward method of trunking, as illustrated in Figure 2, contemplates the selection of an idle trunk by the originating "A" operator, a means for connecting the terminating "B" operator to the trunk selected without loss of time and without undue effort on her part, and the passing of the called number by the "A" operator over the trunk on which the call is to be completed. This passing of the number desired is heard by the calling subscriber. In Table 1 a comparison is made of the essential features of the call circuit

and straightforward operating methods and possibly this brings out some of the operating details more clearly than would a lengthy description.

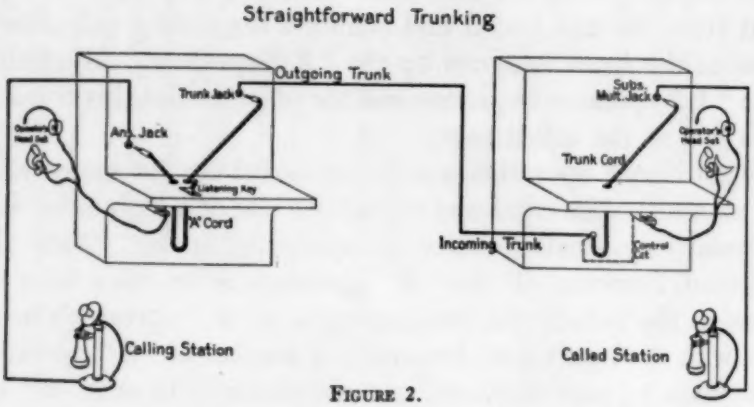


FIGURE 2.

As previously stated the number of errors resulting with call circuit operation was not large, but they are fewer with straightforward operation. This follows since the "A" and "B" operators who are completing a specific trunk call have exclusive use of the trunk at the time when the called number is passed and thus any confusion due to other operators breaking in is eliminated. Further only the called number need be passed, whereas with the call circuit method the number desired must be passed as well as the number of the trunk to be used, thus offering two chances for error. Also this method offers a check against errors in that the calling party hears the "A" operator give the number to the distant "B" operator and can immediately correct her if she repeats the number in error.

The expectations of improved service due to a reduction in the number of errors have been generally realized in the application of the straightforward method in the larger multi-office cities in the Bell System.

Another traffic advantage, due to the simplicity of the straightforward operating plan, is the lessened effort required

for instructing both "A" and "B" operators. The operation of the call circuit has always been a difficult matter to teach,—many weeks of actual operation at the switchboard being necessary before operators became proficient in establishing trunk connections.

Another operating advantage is the fact that the trunks no longer need be grouped by central offices with the associated call circuit at the "B" positions. With call circuit operation this grouping had to be continually studied in order that there might be no overloading of any section of the switchboard with its consequent reaction on the service. Any marked change in the traffic trunked between offices required a rearrangement of the trunks at the "B" switchboard, which in the long run involved a considerable expense. With the straightforward method, the trunk groups may be divided within certain limitations and the individual trunks located anywhere along the trunk switchboard, which flexibility considerably lessens the cost of regrouping the trunks as changes occur in the volume of traffic handled.

An important operating change which fits in particularly well with the straightforward trunking plan is referred to as "restricted repetition," and consists in using the phrase "thank you" instead of repeating the order given by a subscriber. As previously mentioned, the straightforward trunking method permits the subscriber to hear the passing of the number to the "B" operator and affords an opportunity to correct it at that time. This makes a repetition unnecessary when the subscriber first gives the number desired to his "A" operator.

The use of "restricted repetition" effects somewhat of a reduction in the "A" operator's work time. As a result, therefore, of straightforward trunking and "restricted repetition" the working time of both the "A" and the "B" operator in handling a trunk call is decreased and this is reflected in an

operating economy, tending to offset the higher equipment costs of this more accurate method of trunking.

The principal equipment difference between the "straightforward" method and the "call circuit" method is found in the equipment at the "B" position, and at the tandem position in the case of tandem trunks. This is the equipment employed in connecting the trunk operator's telephone set to the trunk which has been selected and also that used for disconnecting the set after the desired order has been passed by the "A" operator. Several plans have been developed, each apparently having its field for a given set of conditions. The simplest method so far as equipment changes are concerned has been given the name of "jack listening" since the "B" operator plugs the trunk which has been selected by the "A" operator into a jack associated with the "B" telephone set, and disconnects after receiving the order from the "A" operator. Another method is called "key listening," where the "B" operator's telephone set is connected to the trunk as long as she depresses a listening key which is associated with that particular trunk. Another, the "automatic listening" method, employs an equipment arrangement whereby the "B" operator's telephone set is connected to the trunk automatically, that is, without requiring any action on her part. When trunks are taken up by the "A" operators at a more rapid rate than the connections can be established by the "B" operator, the waiting calls are connected to the "B" operator's set in the order of a sequence which moves from left to right over the trunks on the position. The "B" operator's telephone is disconnected either by the operation of a release key or by the plugging of the trunk cord into the multiple.

In general, the automatic listening method, while the most expensive from an equipment standpoint, is justified for machine ringing "B" positions if several positions are involved and also for tandem positions at new tandem switchboards. The key per trunk scheme, that is, the association of a listen-

ing key with each trunk, is particularly applicable to manual ringing "B" positions, to key display call indicator positions which are being temporarily operated on a straightforward basis and to tandem positions at existing tandem switchboards. The jack listening method is limited to certain small outlying offices where the number of calls handled is limited and also as an emergency safeguard where automatic listening is provided.

Figure 3 illustrates in schematic form the arrangement of the fundamental circuits at automatic listening "B" positions. The following paragraphs describe briefly the principal operating features:

1. Ten trunks splitting.

   The incoming trunks are arranged in groups of ten so that by means of splitting keys the "B" operator's set may be associated with any consecutive multiple of ten trunks. Thus she may handle 20, 30, 40, etc., trunks depending on the number of calls. This flexibility permits force adjustment in close relation to the actual traffic.

2. Release key.

   A release key permits the "B" operator to release the trunk and thus be in a position to receive a new call, while she is establishing connection on a trunk just released. This makes possible an overlap of work which tends to decrease the "B" operator's work time. In case the "B" operator fails to operate the release key the insertion of the trunk plug in the jack of the called line or in a busy-back jack will also release the "B" operator's set.

3. Pilot lamps.

   A pilot lamp associated with each ten trunk unit facilitates the location of a trunk that has been automatically connected with the "B" operator's set.

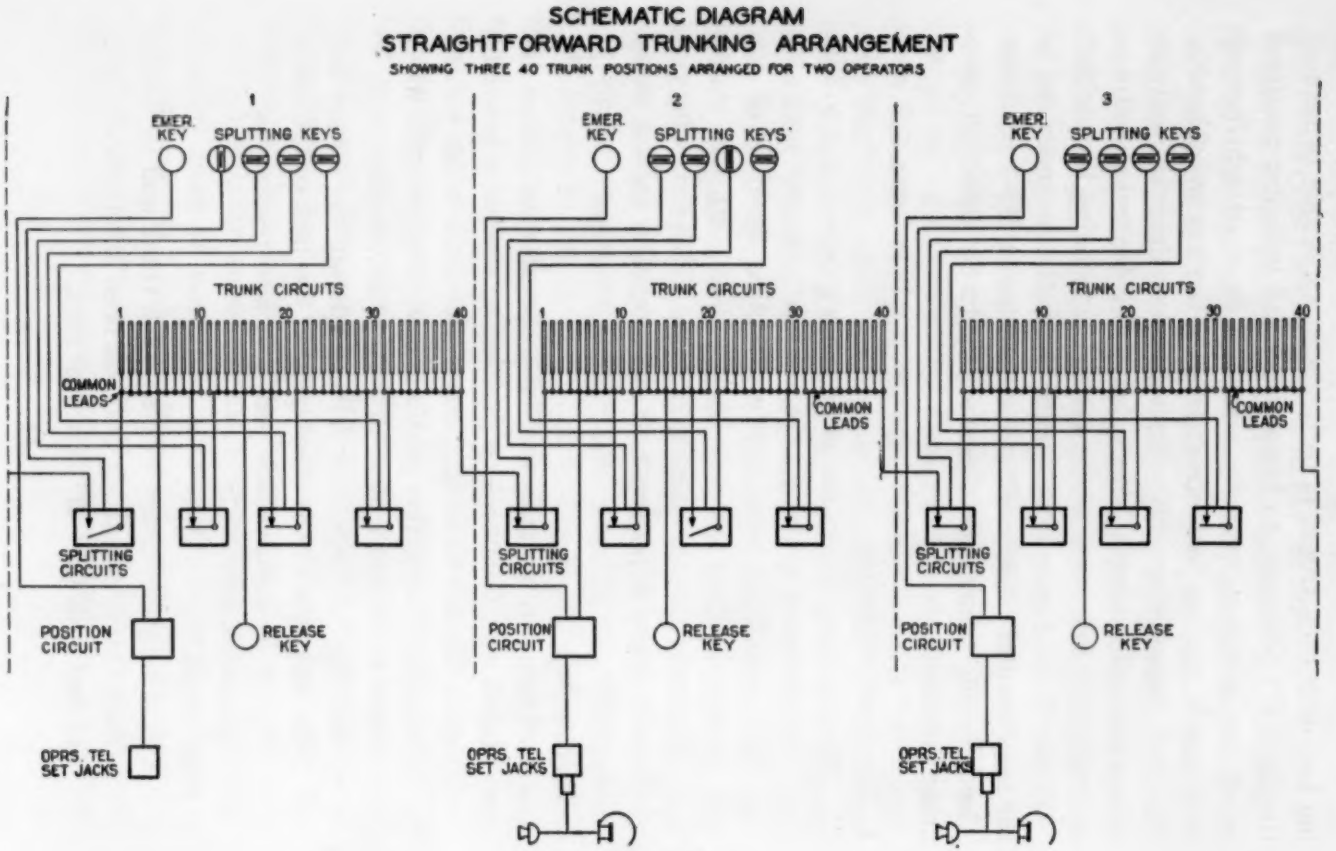

SCHEMATIC DIAGRAM
STRAIGHTFORWARD TRUNKING ARRANGEMENT
SHOWING THREE 40 TRUNK POSITIONS ARRANGED FOR TWO OPERATORS
1
2
3
EMER. KEY
SPLITTING KEYS
TRUNK CIRCUITS
1
10
20
30
40
COMMON LEADS
SPLITTING CIRCUITS
POSITION CIRCUIT
RELEASE KEY
OPRS. TEL SET JACKS

FIGURE 3.

4. Locking disconnect and reselection while the trunk is in the subscriber's multiple.

   If a trunk has been disconnected at the "A" end and then reselected before the "B" operator has taken down the connection, the disconnect signal remains lighted at the "B" board. If this trunk comes within the sequence of selection at the "B" positions before disconnection takes place, the signal then flashes and the "B" operator's telephone set is associated with the trunk in the usual manner.

5. Automatic peg count.

   A peg count register for each "B" position is operated by the depression of the release key or by the insertion of a plug into a jack thus automatically giving a numerical record of the calls handled.

6. All trunks busy registers.

   A register is associated with each incoming trunk group which indicates each time that all of the trunks are busy. Information obtained from these registers is used in engineering the trunk plant.

7. Emergency listening jacks.

   Listening jack circuits are provided for the rather rare cases where the automatic listening apparatus may be in trouble. The "B" operator, by plugging the trunk which has been selected into this emergency jack, connects her telephone set and is thus in a position to obtain the order.

Coming now to a consideration of some of the operating features at "A" positions where the trunking is on a straightforward basis, several methods have been developed whereby the "A" operator may quickly secure an idle trunk to the terminating office. The following table briefly outlines these methods and also gives their general field of application, the par-

ticular method for any case being selected after a careful review of all the factors.

Method of Securing Trunk	*Size of Trunk Group*
Regular trunk busy test.	Up to 20 trunks.
Regular trunk busy test supplemented by master busy on every fifth jack.	From 20 to 40 or more trunks, depending upon length of "A" switchboard.
Idle trunk and position indicating, designated "trunk indicating" for brevity.	From 30 trunks up depending upon length of "A" switchboard.

The first two operations are well known in telephone practice. The last is a development brought about by straightforward trunking and is an arrangement whereby an idle trunk at an idle "B" position is indicated by a lighted lamp associated with the outgoing trunk jack at the "A" switchboard. With this operating method the "A" operator merely has to locate the lighted lamp in the outgoing trunk multiple, plug into the associated outgoing trunk jack and immediately she is connected to the "B" operator, which is evident from the tone that she hears. The labor of testing by the "A" operator is thus reduced to a minimum and the selection of an idle "B" operator speeds up the answer slightly. There is the further traffic feature that the distribution of the calls over the group of "B" operators, resulting from the selection of an idle "B" operator, tends to make all answers approximate the average answer, eliminating the longer intervals sometimes occurring where there is no distribution of the calls.

Various ways were considered for cheapening the equipment costs of the lamp indicating arrangement which necessarily are rather high. One plan omits the lamps and lamp sockets from every other appearance in the out trunk multiple, thus splitting the trunk group into two parts so far as the lamp appearances are concerned. This reduces the number of lamps and lamp sockets by one-half and the equipment charges by an appreciable amount, although not in direct proportion. Going a step

further, under certain conditions the lamps are provided only in every third appearance. It should be noted, however, that with the trunk group split into either two or three parts as just stated, there is a resulting loss in efficiency in the carrying capacity of the individual trunks. In order to reduce the number of excess trunks required by this split of the trunk group, the "A" operator tests for an idle trunk in the group not provided with lamp indicating equipment whenever all the trunks in the group having lamps are busy. Such calls, of course, entail extra operating labor but with a proper division of the group an overall economy is effected, since this extra labor is not excessive and little additional trunk equipment is required.

Where idle trunk and position indicating lamps are not available, the work of testing can be facilitated by providing preferential markings of the trunks throughout the out-trunk multiple so that each jack in a trunk group is marked as a first choice for testing for one or more "A" operators. This results in spreading the traffic more uniformly over the trunk group with the result that any "A" operator finds an idle trunk immediately on a large proportion of calls.

While the description so far in this article has been that of the straightforward method for completing traffic between manual offices, the same principles have been applied to the traffic outgoing from a manual to a dial office. The trunks incoming to the dial office terminate at dial system "B" positions where the trunks are associated with suitable apparatus whereby the "B" operator is connected to a trunk that has been selected by an "A" operator. The call is passed in a straightforward manner and the called number set up on a key set by the "B" operator. The connection is then established through the series of selectors to the desired subscriber's line.

In the larger cities the trunking plant represents a considerable capital investment so that it is the subject of continual study to insure the provision of an adequate plant, yet one rep-

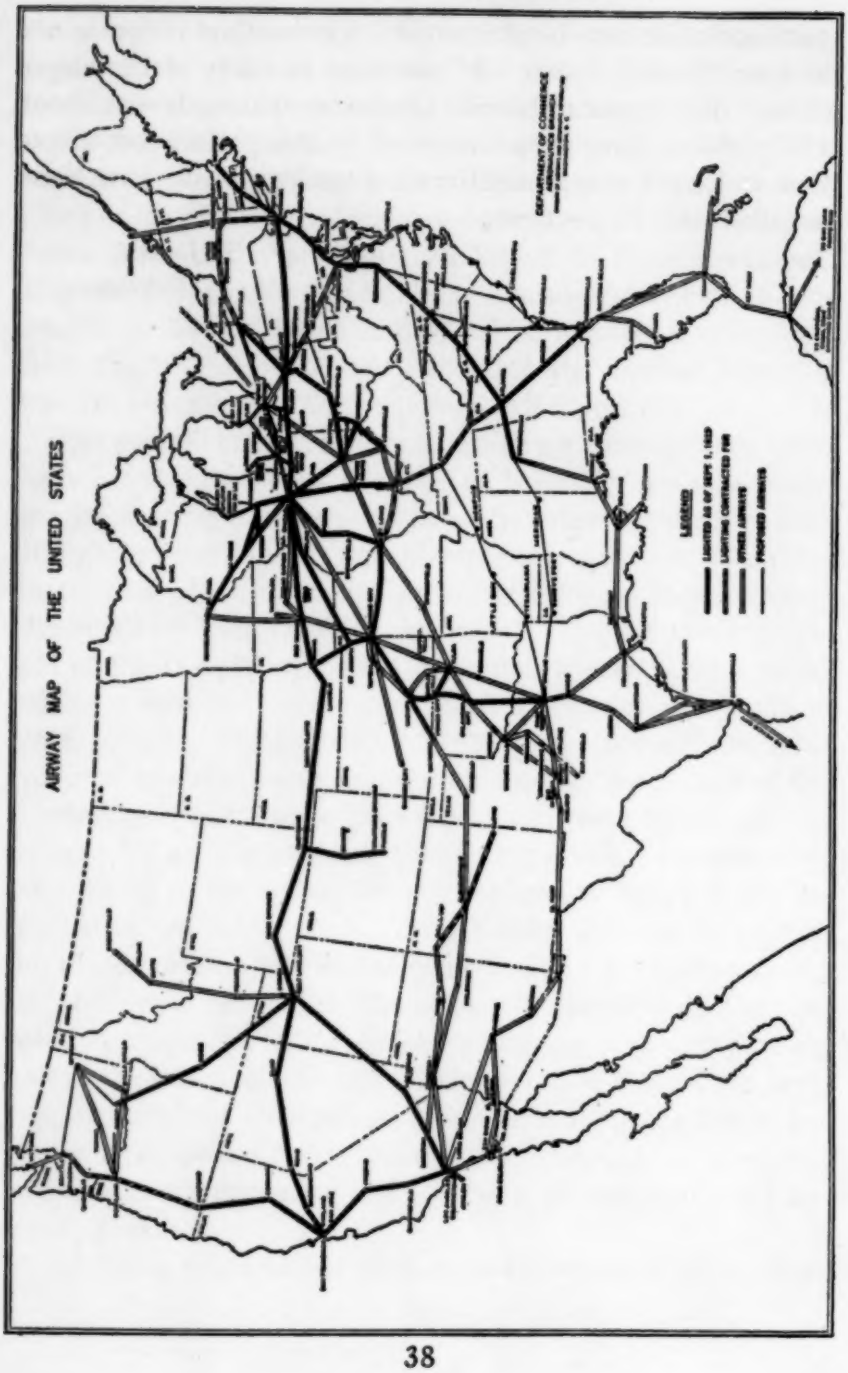
resenting the most economical plan consistent with furnishing good service. In such a trunking plan there is frequently a field for a tandem operating method. While ultimately this tandem traffic may be handled by machine switching equipment, for a number of years to come, in many cities the service can best be given through a manual tandem switchboard. The straightforward method is particularly adapted to these conditions, since the operating errors can be practically cut in half as contrasted to the call circuit method, which involves a call circuit from the "A" to the tandem operator and another from the tandem operator to the completing "B" operator.

The manual tandem boards in the larger Metropolitan areas have been converted or replaced so that they are now working on a straightforward basis. The latest type of manual straightforward tandem switchboards are equipped with automatic listening trunks, similar in operation to those already described for local trunking operation. The out trunk multiple of the completing trunks extending to the various called offices is equipped with lamps which indicate an idle trunk in each outgoing trunk group. These lamps are of particular value at tandem boards because such a high proportion of the tandem operator's work time would otherwise be devoted to testing for an idle outgoing completing trunk. Furthermore, any saving in the testing time at the tandem board is also reflected in the "A" operator's work time since she is waiting on the connection to pass the order to the "B" operator, and this in turn is reflected in the service by speeding up the connection to some extent. An interesting development growing out of the introduction of the straightforward method has been the extension of the tandem areas by routing the traffic between more distant points through tandem boards as compared with the more expensive and somewhat slower toll board operating method.

In closing this article a word as to the extent of straightfor-

ward operation may be of interest. This method is now in use at approximately 7,000 "B" positions in thirty of the larger cities. Ten former call circuit tandem switchboards with about 450 positions have been converted to straightforward operation, and eight new straightforward tandem boards have been installed with 70 positions.

F. S. JAMES,
W. E. FARNHAM.


AIRWAY MAP OF THE UNITED STATES
DEPARTMENT OF COMMERCE
LEGEND

Communications for Aviation

Present Status of Aviation in the United States

THE past year has witnessed important developments in virtually every phase of civil aeronautics. Spectacular achievements have combined with regularly scheduled operations to popularize air transportation. It has been estimated that more than half a billion dollars is now invested in the airplane industry in the United States.

During 1928, 35 companies operated over civil airways 50 scheduled air lines and flew a total distance of 10,673,450 miles. These operators transported 49,713 passengers, 1,848,156 pounds of express, and 4,063,173 pounds of mail.

There are now 29,227 miles of established airways in the United States. More than 10,000 miles of these airways are lighted for night flying and 2,065 miles are in process of being lighted. The accompanying map shows the airways throughout the country as of September 1, 1929.

On November 1st the Department of Commerce reported that 82,816 plane-miles are flown daily on scheduled routes within the United States. In addition 8,301 plane-miles are flown daily on so-called foreign routes; that is, from points in the United States to Canada, the West Indies, Central and South America.

On September 30th the Department of Commerce reported a total of 1,460 airports and landing fields and 1,050 proposed airports. Of the established airports, 171 are lighted for night flying. The remainder are unlighted airports, intermediate landing fields, etc.

It is reported that there are now 86 air lines of which 13 carry mail, express and passengers, 9 carry mail and passengers, 14 carry passengers and express, 6 carry mail and express,

12 carry mail only, 2 carry express only, and 30 carry passengers only.

The Department of Commerce on November 1st reported 5,764 active airplane licenses and 3,095 active airplane identifications. Airplanes engaged in interstate transportation of goods or passengers must be licensed. Other airplanes may be identified, but no license or identification is required by the Federal authorities for airplanes used solely within a state. However, some states have passed laws requiring Federal licenses for intrastate traffic and it seems likely that similar laws may be adopted for other states. The figures given above are the best available for the number of airplanes in use in the United States. No figures for the airplanes engaged in the various services are available except that for the year 1928 some 28 companies out of 41 reported 268 planes engaged in air transport, presumably over scheduled routes.

Naturally, scheduled air transport operations receive the most attention. However, these scheduled operations account for only one-sixth of the total flying in the United States. Other miscellaneous air services include sight seeing, student instruction, crop dusting, aerial photography, mapping, messenger service, advertising, charter or taxicab service, etc. It is estimated that during 1928 about 60,000,000 plane-miles were flown by such miscellaneous services. There is also some private flying.

Communications

Communications are essential to the operation of air transport lines and in considering the forms of communication required they may be conveniently divided into: (*a*) ground to plane communication, and (*b*) communication between points on the ground.

Ground to Plane Communication

Of course, the only means for communication between points on the ground and planes in flight is radio and three distinct

kinds of communication are required:

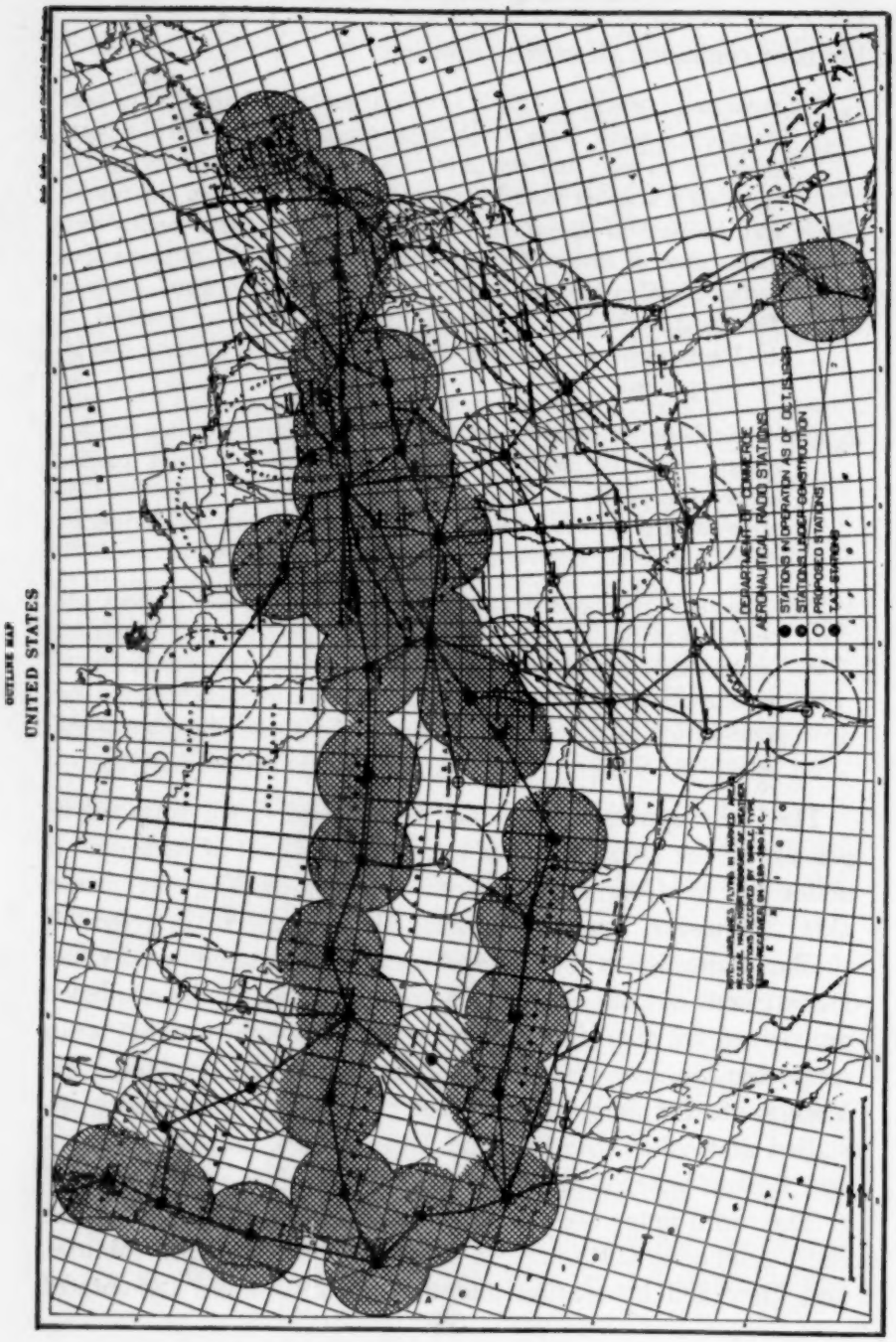
1. The radio range beacon. This is a radio transmitter located at or near important landing fields which sends out a relatively narrow beam along the airway; and the pilot in an airplane by picking up the signal on a suitable receiving set is enabled to keep on the course. Two methods of operation of the range beacon have been developed. One of these uses a visual indicator in the airplane consisting of vibrating reeds, and the other uses an aural method. The aural method is used for the range beacons now installed by the Department of Commerce and by some of the airplane operating companies.

2. Radio telephone transmitters for the purpose of transmitting weather reports and other information from the more important landing fields to airplanes in flight. This information is transmitted on wave lengths between 850 and 1,050 meters and picked up by suitable receiving sets on any airplane in the vicinity.

3. Two-way radio telephone communication between ground stations and airplanes in flight. This will be for the purpose of transmitting weather information and instructions to pilots, with the ability to get a reply from the pilot so that assurance may be had that the message has been received. This will also enable the pilot to call the ground station and ask for such information as he needs.

The radio apparatus discussed in (1) and (2) is supplied in general by the Department of Commerce as part of its function under the Air Commerce Act of 1926 in providing navigation aids. However, Transcontinental Air Transport has provided similar transmitters for its landing fields not equipped by the Department of Commerce. The receiving sets in the airplanes are owned by the airplane operating companies. The radio range beacon has been in operation on the Cleveland-New York route for more than a year. Recently it has been installed at Goshen, Sterling and Des Moines, and the Chicago and Boston beacons are now being installed.

The radio range beacon is operated in conjunction with the radio telephone stations. It is stopped every fifteen minutes and identified by station announcement followed by correct


OUTLINE MAP
UNITED STATES
DEPARTMENT OF COMMERCE
AERONAUTICAL RADIO STATIONS
STATIONS IN OPERATION AS OF OCT. 1, 1938
STATIONS UNDER CONSTRUCTION
PROPOSED STATIONS
TAT STATIONS

time and weather reports. This system has a number of advantages in that the pilot does not have to change the tuning of his receiver and is listening at all times for either radio range beacon signals or weather information. In this way it is possible to interrupt the beacon at any time and communicate emergency messages to the pilot in flight.

The accompanying map shows 25 government ground radio telephone stations for transmitting weather information to planes, in service on October 15, 1929. The map also shows 5 stations operated by Transcontinental Air Transport, 14 stations under construction and 29 proposed stations.

The two-way telephone apparatus discussed in (3) is not provided by the Department of Commerce. This two-way telephone communication will be required by the airplane operators who undertake the transport of passengers. These operators must provide every means possible to insure the safety of passengers and it is expected that they will provide their own two-way radio telephone systems.

A variation of the general plan for two-way radio telephone communication is a proposal to equip the more important landing fields with relatively low power two-way radio telephone sets, with the expectation that itinerant flyers will have their planes equipped with two-way sets so that when they are approaching a landing field they may communicate with the ground and obtain landing information and instructions. It is expected that all of these low power sets will be operated on one frequency to facilitate the establishment of such communication between any plane and any landing field.

There appears to be a field for combined radio telephone and telegraph sets where aircraft are flying long distances over water as from Florida to the West Indies, but for flying within the United States probably radio telegraphy will not be used.

Already there has been some demand for wire circuits to connect the radio telephone ground stations with nearby points for

remote control operation, and some of the telephone companies are furnishing such circuits.

It does not seem likely that there will be any real demand in the near future for radio telephone communication with passengers in airplanes, in the sense of providing connection to ground stations for regular exchange and toll service. Moreover, the airplane operators appreciate that the radio facilities now contemplated cannot be used for passenger communication without jeopardizing their primary function which is the safe navigation of the airplane. It probably will be possible for passengers to write out and hand messages to the radio operator on the airplane in an emergency for transmission to a ground station where the messages may be retransmitted by either telephone or telegraph.

The Federal Radio Commission has announced that radio frequency assignments for aviation will be made only where the services so established will be available generally to all who may wish to use them. This, as well as the conflict of interest where two or more companies are operating planes over the same route, has led to the suggestion from the technical committee of air transport operators that a communication company be formed for the United States to which frequency assignments will be given and which will undertake to own and operate all the radio facilities for aviation, except those facilities furnished by the Department of Commerce. Just how this may work out is as yet uncertain.

Communication Between Points on the Ground

It has been suggested that radio telegraphy might be used for communication between landing fields. This may perhaps be an economic way to provide such communication where the volume of traffic is small, or where wires are not readily available, but with the continued growth of civil aviation it seems certain that the use of wire lines for such communication can be justified at least on the more important routes.

The Department of Commerce is using the telephone typewriter service for communicating between Newark, Chicago and 17 intermediate points as well as Maywood near Chicago; and for communicating between Reno, San Francisco, Los Angeles, San Diego and some 15 intermediate points. Private airplane transportation companies have telephone typewriter service between Los Angeles, Kingman, Winslow, Albuquerque and Clovis; between Waynoka, Wichita, Kansas City, St. Louis, Indianapolis, Columbus, Akron and Cleveland; and between Newark, Philadelphia, Baltimore, Washington, Richmond, Greensboro, Spartanburg and Atlanta. It is expected that similar service will soon be extended from Atlanta to Jacksonville and Miami.

The principal function of the telephone typewriter service is to transmit weather information between the principal airports on an airway, but it may also carry a considerable volume of routine messages in connection with the operation of the air line. In addition to this it is necessary to collect weather information from points near the airway but not on it. Ordinary telephone calls are being used to a considerable extent for this purpose. Also a number of local telephone typewriter services are being used for communication at or near an airport between the radio station, the weather bureau and, in some cases, the Post Office and operating company's offices.

Continued growth of the air transport industry will undoubtedly result in a very large increase in the wire communications required. In the past generally the air transport traffic has not been sufficient to justify private line facilities for air transportation companies, but the growth of their business, particularly in passenger carrying, probably will make such facilities necessary in the near future.

Facilities for the Public at Airports

With the advent of air passenger transport adequate pay station telephone facilities must be provided at airports, and

the information available indicates that this situation is being taken care of as it develops. Also, the telegraph companies are providing public telegraph offices at some of the principal airports.

Lighter-than-air Craft

The recent trips of the *Graf Zeppelin,* have focused attention upon the possibilities of airships for the transportation of goods and passengers. It seems that the commercial use of such ships is still rather far off although a company has been formed in the United States, which, it is understood, looks toward establishing trans-pacific and later trans-atlantic air transport lines using ships of the Zeppelin type.

While airships present certain advantages especially for long flights over water, where at present airplanes cannot be safely used, it seems that they also have certain disadvantages, the more important of which are relatively high first cost in proportion to the useful load, and large ground crews and special facilities required for landing. They are also more subject to adverse winds than airplanes because of their lower speed.

One airship of 5,000,000 cubic feet capacity has been completed and another ship of the same size is nearing completion in England. The construction of two ships of 6,500,000 cubic feet capacity for the United States Navy has been started in this country. In addition, an interesting metal clad airship of 202,200 cubic feet capacity has recently been completed for the Navy. This little ship is intended to demonstrate the practicability of the metal clad construction.

The communications required for such ships it seems would be of the nature of ship-to-shore radio telegraph and radio telephone service. The radio facilities provided for aircraft would be available for airships where they are flying over established routes, as in the United States or West Indies.

R. W. Armstrong.

International Radio Technical Conference at The Hague

LAST September there was held at The Hague the first meeting of the newly organized International Technical Consulting Committee on Radio Communication, known as the CCIR. This committee corresponds in radio to the two consultative committees having to do with international wire communication, the CCI Telephone and the CCI Telegraph.

Since international conferences on electric communications are occurring rather frequently these days, it may be well, in the first place, to identify more definitely these several committees. In general, the two wire committees and the radio committee go back for their authority to two different international conventions or treaties upon the subject of electric communications:

(1) The wire convention, known as the International Telegraph Convention and Regulations. This convention is an outgrowth of wire connecting agreements between the European nations and has now come to include a number of countries outside of Europe. It is not set up to take account of the U. S. situation in electric communications, however, and for this reason the U. S. Government is not an adherent.

(2) The radio convention, recently revised at Washington and known as the International Radiotelegraph Convention of Washington, 1927. This is an outgrowth of the use of radiotelegraphy for safety of life at sea and is concerned largely with wavelength matters. The U. S. Government is an adherent.

It is the wire convention with which are affiliated the two

wire consultative committees referred to above, the CCI Telephone and the CCI Telegraph. These wire committees have as their object the agreeing upon plant standards and operating practices for international communication circuits. The American Telephone and Telegraph Co. has from time to time collaborated with the CCI Telephone and has recently become a member of this committee, in view of the company's direct interest in telephone connections to other continents.

The CCI Radio, which recently met at The Hague, is organized under the Radio Convention " for the purpose of studying technical and related questions." Like the wire consulting committees, its activities are limited to the formulation of advice. The Radio Committee is concerned primarily with the problems which inhere in the fact that in radio the nations share a common transmitting medium, the outstanding technical problem being that of how to derive the maximum number of channels and minimize mutual interference. The activities of the Committee are of a two-fold interest in the United States: (1) to the Government, in respect to the regulatory application of the technical advice, and (2) to the operating agencies, in respect to the engineering of plant and the operation of radio channels.

Attending the recent Hague meeting were, therefore, both government and company representatives. The United States Government sent quite a complete delegation, headed by Gen. Saltzman, formerly Chief Signal Officer of the Army and now a member of the Federal Radio Commission. Practically all of the American communication companies interested in radio had representatives present. The Bell System was represented by Dr. W. Wilson, of the Bell Telephone Laboratories and the writer, with Mr. DeCoutouly, of the Bell Telephone Laboratories, assisting as interpreter.

Results of the Hague Conference

The outcome of the recent conference at The Hague can perhaps best be summarized by setting forth the principal subjects upon which recommendations were made, rather than the detailed recommendations themselves, as follows:

(1) Methods for comparing the frequency standards of the different nations and for measuring frequencies internationally, so that a given frequency assignment will mean the same the world over.

(2) Accuracy with which stations should be expected to hold to their assigned frequencies.

(3) Width of frequency band which is occupied by a given type of transmission, *i.e.*, telephone, telegraph, television, etc.

(4) The frequency intervals at which stations should be assigned.

It will be seen that all of this is concerned with the problem of carving up the frequency spectrum into the narrowest bands permitted by the art, for the purpose of squeezing in the maximum number of stations and of giving an indication of how many channels the world may expect to have at its disposal without undue interference.

It is of interest to note what the recommendations of this conference indicate as to the number of channels which can be simultaneously utilized in the world. With the existing engineering practice the entire known radio spectrum may be resolved into some 3,000 or 4,000 individual bands so spaced that each channel is more or less free from interference. A certain portion of the radio spectrum is only regional in its transmission effects and will permit a number of simultaneous uses to be made of the same channel at widely separated points on the earth. Other portions of the spectrum are, however, so world-

wide in their effect as to greatly limit the extent to which channels can be duplicated. As compared with these present possibilities, there are already registered at the Berne Central Bureau some 9,000 frequencies for use throughout the world. It is apparent, therefore, that a large proportion of the channels which the present art can yield are already in use or bespoken.

Two definite improvements now within view may be expected to increase the effective communication capacity of the ether. One enables the wavelength of the station to be maintained closer to its assignment, thereby minimizing waste wavelength space, while the other increases the selectivity of the receiver, thereby excluding undesired signals in closely adjacent bands. The Hague Conference recognized these possibilities and recommended advanced standards based upon them. When these improvements become more or less universal, certain parts of the spectrum may be resolved into still narrower channels with a corresponding increase in the number of facilities. In general, the realization of these advances in practice will be gradual, since it is dependent on political and economic factors. There is, of course, a great difference between the nations in respect to their communication policies and their readiness to replace obsolete equipment in order to conform with higher technical standards.

The more administrative problem of dividing the frequency spectrum into wide bands for assignment to various classes of service was one of the most important ones dealt with at the Washington 1927 Conference. This question was intentionally avoided by this technical conference, as were also the related questions of rights to and responsibilities in the use of individual radio channels. These questions will need to be developed further at the next general international radio conference, due to be held at Madrid in 1932. Incidentally, there will also be before that meeting a proposal which has been advanced by the European countries, to unite the two existing conventions,

the radio and the wire, into one general communications convention.

Internal Aspects of the Conference

Further points of interest concerning the complexion and the working of the conference itself are as follows:

(1) There were about 200 technical people present, representing both governments and companies, from some 40-odd countries.

(2) All findings were adopted unanimously, and the problem of voting was thereby avoided. As the committee is constituted, the voting power is exercised by the government representatives of the various countries, unless a country is represented solely by companies. There remained unsettled the question of what this voting power should be, whether each country should have a single vote or whether, as has been done in other radio conferences, the greater stake of the larger countries should be recognized by giving them a plurality of votes.

(3) Strange as it may at first seem for a communications conference, one of the most difficult problems proved to be the one of how the delegates should communicate with each other on the floor! In keeping with diplomatic custom, French was recognized as the official language of the Conference. Some of the European countries wished to confine the proceedings to French, but this would have prevented the delegates from some of the English-speaking countries, particularly those from the United States, from participating adequately in the Conference. The arrangement finally agreed upon was that a representative could speak in his own tongue, providing a translation were made immediately into French, and that a delegate could call for a translation into "one other language" of a presentation made, in

the first place, in French. The only "other language" availed of was English. In fact, it was used quite generally along with the French throughout the Conference, since about as many delegates understood English as understood French.

(4) The carrying on of the Conference was facilitated by the excellent arrangements which had been made by the Netherlands Government and by the secretarial staff of the International Bureau for the machinery of the Conference. The Conference was short, two and a half weeks, and the work was intensive. Pleasant relief was afforded by visits to radio plants and other places of interest in Holland.

Questions Remaining

At the conclusion of the Conference there were a number of questions which the Conference desired to have studied in the interim before the next meeting of the CCIR, set for Copenhagen in 1931. Each of a number of countries volunteered to take the initiative in the study of one or more of the problems and formulate proposals for the next meeting. Thus, the subject of ship-to-shore telephony, which was discussed in the Conference but which was thought to be premature for the setting up of a technical plan, was taken by Germany for further study, with the United States and a number of other nations volunteering to co-operate. The problem of co-ordinating frequency assignments in the mobile service bands was undertaken by the United States, with other nations collaborating. France undertook the study of measuring voice and noise levels in radiotelephone links between wire networks; Austria agreed to study the subject of single sideband transmission. Such allocation of work is an attempt to simplify the preparations for the next conference, but is not intended to exclude a country from submitting its own proposals where it sees fit to do so.

Lloyd Espenschied

Abstracts of Technical Papers from Bell System Sources

Further Note on the Ionization in the Upper Atmosphere,[1] by J. C. Schelleng. In this paper Mr. Schelleng records certain considerations that were omitted from a previous paper which omission resulted in some difficulty.

The Use of Continued Fractions in the Design of Electrical Networks,[2] by Thornton C. Fry. In U. S. Patent No. 1,570,215 and in several technical papers by Bartlett and Cauer it has been shown that continued fractions can often be used in designing networks with pre-assigned impedances. The chief difficulty of the method has been that it frequently required the structures to contain negative resistances, inductances or capacities and therefore the results, though correct in theory, were often worthless in practice because the networks could not be constructed.

The present paper removes this difficulty in virtually all cases where the analytic character of the desired impedance is known, that is, where it can be represented by a formula and not merely by a graph. In such cases the choice of a type of structure, as well as the assignment of values to the elements, becomes almost a matter of routine with the definite assurance in advance that no negative elements will be required.

The Mutual Impedance Between Adjacent Antennas,[3] by Carl R. Englund and Arthur B. Crawford. The simple theory for the computation of reflecting or multibranch antenna systems is sketched. If the points at which observations of elec-

[1] Proceedings of the Institute of Radio Engineers, August, 1929.
[2] Am. Math. Soc. Bull., July–August, 1929.
[3] Proceedings of the Institute of Radio Engineers, August, 1929.

trical quantities are to be made are definitely specified, a knowledge of the self and mutual impedances (properly defined) between antennas is sufficient to make the computations determinate. Of the circuit constants, the most useful and accessible is the antenna current ratio

$$K_{12} = \frac{I}{I_1} = K_0 e^{i(\phi - (2\pi d/\lambda))}$$

and in the work here reported ϕ has been measured in the range 0.33 λ to 1 λ. Experiment has shown that in this range ϕ is that theoretically calculable for a Hertzian doublet. Actually this range is equivalent to $\lambda/3$ to ∞. The discussion of experimental procedure is purposely thorough.

Telephone Communication System of the United States,[4] by Bancroft Gherardi and F. B. Jewett. This paper presents the results which have been obtained up to the present time in developing telephone communication in the United States of America, this development having been worked out in a form to meet the particular conditions which present themselves in that country. The paper first deals with a brief description of the general structure and organization of the telephone communication system giving the organization of the Bell System which handles the greater part of the telephone service of the country and the reasons for and advantages of this organization. In this connection some figures are presented with respect to the technical personnel who are continuously engaged in studies to develop the art and to provide new methods and facilities for improving the service.

Local service, that is the service within the limits of a single telephone exchange area, is next discussed. Figures are given with respect to the volumes of telephone calls handled in the Bell System, the speed with which the connections for these calls are completed and the operating force required. Ref-

[4] Presented by Dr. F. B. Jewett before the World Engineering Congress, Tokio, Japan, October, 1929, Bell System Technical Journal, January, 1930.

erence is also made to the standards of transmission given and the various problems encountered in meeting these standards. Figures are given with respect to station growth, to the increased efficiency of station apparatus and to the improvement in types of instruments. Various types of private branch exchanges provided to meet the needs of customers using a large amount of telephone service are discussed. The cable plant is considered mainly from the construction standpoint and typical illustrations are given of some of the construction practices. The various types of central office switching systems in common use are described, including magneto, common battery and dial systems, the latter including both the step-by-step and panel systems which are being provided in increasing amounts in the Bell System. The subject of buildings to house these various equipments as well as the operating forces and headquarters staffs in many cases is briefly discussed, also standardized layouts and floor plans. The problem of giving telephone service in the rural communities, which is a very important one in the telephone development in the United States, is also briefly treated.

The toll service is considered, first with respect to the shorter haul toll business and the problems involved, and then with respect to the long distance toll service. Figures are given showing the speed of service and the amount of traffic handled. For the short distance toll service, two important methods of handling the business are described, namely, manual straightforward tandem and dial tandem.

The long distance service, which has developed most rapidly in recent years, is described in some detail in the paper. Among the important features of this service is noted the recently developed method of completing toll calls with sufficient speed so that on most of the calls the calling subscriber remains at the telephone. The various types of toll circuits are described including open wire circuits operated both at voice frequencies and by carrier systems and long toll cable circuits.

The operation of these long circuits requires a large number of repeaters in tandem and the design and maintenance problems which this arrangement requires are pointed out in the paper.

Information is given with respect to international telephone connections in North America, between North America and Europe and other international connections. In covering this subject some of the important items relating to the operation of the transatlantic radio channels are given and reference made to the projected transatlantic telephone cable.

Various forms of special services closely allied with the message telephone service are described. These include telegraph service, telephone circuits provided for private use, foreign exchange service, telephone networks for program transmission to radio broadcasting stations, electrical transmission of pictures, telephony in connection with aircraft operation, ship to shore telephony, telephony to mobile stations such as railroad trains, telephone services of railroads and other public utilities, telephone public address systems and television. Reference is also made to some of the by-products of the telephone development work which include improvements in submarine cable telegraphy brought about by the discovery of the alloys known as "permalloy and perminvar," the development work in the reproduction of sound and in the talking motion pictures.

In concluding, the paper points out that careful studies of the future development of the telephone industry indicate a somewhat accelerated rate of development of the services required to meet the demands of the customers and a continuing very rapid technical development of telephone plant and systems to provide the necessary facilities.

In treating such a large subject in a paper of this kind it has been necessary to deal with technical problems in rather general terms and as an attachment to the paper references are made to numerous articles in the technical press for the more technical information.

Wire Line Systems for National Broadcasting,[5] by A. B. Clark. The interconnecting of radio broadcasting stations by special telephone lines for the simultaneous broadcasting of radio programs began on a commercial basis in 1923. Today well over 30,000 miles of program transmission circuits are in use in the United States and transcontinental broadcasts by means of such wire lines are a daily occurrence.

The paper first states the radio limitations which make wire lines necessary for broadcast coverage of large nations. A map and data are given showing the present broadcasting chains in the United States and indicating the extent of their use. An explanation is given of why program transmission circuits must have transmission characteristics materially different from message telephone circuits and a brief discussion of some of the important transmission characteristics of such circuits, including particularly "frequency range" and "volume range." The present chains in the United States which are made up almost entirely of open-wire circuits on a voice-frequency basis are briefly described. The manner in which these chains are tested and the way control is exercised are also indicated. To exercise this control requires an elaborate network of telegraph wires now aggregating over 40,000 miles and a corps of special men over 300 in number.

Structure and Nature of Troostite,[6] by Francis F. Lucas. In this paper the structure and nature of the constituent troostite (found in hardened steels) is discussed. High power metallography was first applied to this problem about six years ago and the early results were presented in an address before the Franklin Institute.

Since that time many improvements in technique have been

[5] Presented before the World Engineering Congress at Tokio, Japan, October, 1929. Proceedings of Institute of Radio Engineers, November, 1929; Bell System Technical Journal, January, 1930.

[6] Presented by the author before World Engineering Congress, Tokio, Japan, October, 1929; Bell System Technical Journal, January, 1930.

developed which have resulted in better resolution and definition. The subject has been reviewed in the past two years and with the aid of the improvements in technique, hardened steels are found to be largely mixtures of the things which metallographers call martensite and troostite.

In small specimens of 0.90 per cent carbon tool steel hardened to C-65 on the Rockwell scale, innumerable particles of troostite are found. When these particles of troostite are examined by present high power methods the structure is clearly resolved into laminated pearlite. In certain stages of development of a troostitic nodule its structure borders on the verge of present methods of resolution.

Nodular troostite develops under favorable conditions as a globular mass. At the center is a nucleus about which the growth occurred. Radial, fan-shaped grains extend outward from the nucleus and these grains show orientation phenomena when revolved about the optical axis of the microscope.

It is believed that when martensite forms, the structure develops on the old austenitic crystallographic planes. Troostite appears not to follow the old austenitic system but seems to be a reorientation of the freshly transformed alpha iron about a nucleus which usually is an inclusion, a void, a sharp corner in a grain boundary or some other detail of structure.

The structure of troostite in various stages of its formation is illustrated by means of high power photomicrographs many of which are shown at this Congress for the first time.

The following conclusions were reached:

Nodular troostite appears to be an aggregate of ferrite and carbide and in the very early stages of formation its structure is on the border of present methods of resolution. The condition of the ferrite and carbide in relation to each other is not stable—they tend to stratify forming pearlite.

Troostitic nodules grow about a nucleus which may be an inclusion, a void, a corner in a grain boundary or some other detail of structure. The nodules contain fan-shaped radial grains.

The development of troostite results in a reorientation of the ferrite—seemingly without particular reference to the old austenitic crystallographic planes. Martensite does follow the old system of austenitic planes.

The small fan-shaped grains in nodular troostite may persist as small grains or they may undergo grain growth by union. It is a matter seemingly dependent upon the thermal treatment of the specimen.

Radio Broadcasting Transmitters and Related Transmission Phenomena,[7] by Edward L. Nelson. This paper is a brief discussion of recent developments in American practice concerning radio broadcasting transmitters. Descriptive material and photographs pertaining to several new commercial transmitting equipments are included. Reference is also made to the more important aspects of the related transmission problem. On account of the scope of the subject, the treatment is necessarily superficial, but it may serve to indicate the present status of the transmitter art and its relative position with respect to the industry as a whole. A short bibliography containing some of the more important recent contributions to the subject is attached as an appendix, to which reference may be had for more detailed information.

Contemporary Advances in Physics,—XIX. Fusion of Wave and Corpuscle Theories,[8] by Karl K. Darrow. In this article certain of the simple and familiar phenomena of optics and of electronics—for instance, refraction at a boundary between two media, and diffraction by a grating—are interpreted by both of the theories, undulatory and corpuscular, which have so often been condemned as incompatible with one another; the attitude being, that the theories may be brought into con-

[7] Presented before the World Engineering Congress, Tokio, Japan, October, 1929; Proceedings of Institute of Radio Engineers, November, 1929; Bell System Technical Journal, January, 1930.

[8] Bell System Technical Journal, January, 1930.

cordance by modifying one at least in ways which, extraordinary as they seem, do not quite destroy its character.

Some Principles of Broadcast Frequency Allocation,[9] by L. E. Whittemore. This paper discusses some of the technical factors which must be considered in the allocation of frequencies to broadcasting stations in such a way as to provide the best possible coverage of a given country or continental area.

A given frequency or channel can be used for either of two kinds of service; (1) by one station, exclusively, to give high grade service to the immediate locality and opportunity for service over broad rural areas when transmission conditions are good, and (2) by two or more stations simultaneously, to give local service to a number of separate regions, each of rather restricted area. The problem, therefore, involves a determination of (1) the proper balance between the two kinds of service, rural and urban, and (2) the proper basis for the apportionment of the assignments.

Reference is made to the basis of apportionment of radio broadcasting assignments laid down in the U. S. Radio Act of 1927, and to certain suggestions which have been made for the apportionment of broadcasting frequency assignments among the countries of Europe.

A brief discussion is given of the relation between field intensity, or signal strength, and distance of transmission at broadcast frequencies. The paper also discusses briefly the effects produced in the case of (1) a single station operating exclusively on a "clear" channel, and (2) two or more stations operating simultaneously on the same channel.

It is suggested that the distribution of assignments on "clear" channels, in a given continental area be made proportional to the population of each of several large geographical units or zones and that the distribution of assignments on

[9] Proceedings, Institute of Radio Engineers, August, 1929.

"multiple assignment" channels be made to comparatively small geographical units in proportion to their areas.

An Experimental Method for the Determination of the Ballistic Demagnetization Factor,[10] by Donald Foster. A method is described for experimentally determining the ballistic demagnetization factor. By means of a double search coil of novel design the magnetization and the magnetic field intensity are determined from ballistic galvanometer deflexions. While the discussion refers mainly to circular cylinders, the scheme is adaptable to specimens of other shapes. It is particularly designed to obtain accurate measurements of field intensity in cylinders of small diameter.

Details of a special design are given.

Curves are given which illustrate the variation of the demagnetization factor with the magnetization, as well as the dependence of this relation on the material and on the dimensional ratio.

A Voltage Regulator for Gas Discharge X-Ray Tubes,[11] by F. E. Haworth. This note describes a device used in connection with a gas discharge x-ray tube, to regulate the voltage across it by automatically adjusting a mercury valve between the tube and the pumps, thus controlling the pressure of the gas. It has been used with tubes of the Hadding and Shearer types and has operated satisfactorily for more than a year. It was designed to replace the regulator described by Bozorth, which is similar in principle but has certain disadvantages, for example the moving parts have high inertia and adjustments is required when the atmospheric pressure changes.

The Significance of the Hydrogen Content of Charcoals,[12] by H. H. Lowry. Most studies of the thermal decomposition of

[10] Philosophical Magazine, September, 1929.
[11] Journal of the Optical Society of America, August, 1929.
[12] Journal of Physical Chemistry, September, 1929.

hydrocarbons are confined to an examination of the composition of the liquid and gaseous products. Among exceptions to this generalization may be mentioned the interest in coke, carbon black, and charcoal. Even in these cases the physical properties rather than the chemical composition are regarded as the factors which determine their suitability for specific uses. However, in an earlier paper it was pointed out that certain physical properties of a group of charcoals were rather simply related to the per cent hydrogen which was contained in them as determined by ultimate analysis. This group of charcoals was prepared in a gas-fired furnace from a single, especially-selected lot of anthracite coal. As stated in this earlier paper, careful consideration of the commercial records taken at the time of preparation indicated that the hydrogen content was probably determined by the maximum temperature to which the samples were heated during their preparation. The hydrogen contents ranged from 0.21 to 0.53 per cent, while the probable range of maximum temperature was 900° to 1200°. The presence of hydrogen in these charcoals was shown to be consistent with a point of view that so-called "amorphous" carbons are hydrocarbons of low hydrogen content built up of polymerized residues from the thermal decomposition of hydrocarbons of greater hydrogen content. Since the significance of the hydrogen content of charcoals has been generally overlooked, the present study was undertaken in order to evaluate the factors which may ordinarily be varied in the preparation of charcoals for various purposes. The factors which were independently varied in this study were the maximum temperature, the time of heating, the atmosphere surrounding the sample during heating and the raw material. To a limited extent the effect of previous heat treatment was also determined. A later paper will give the results of the study of the correlation of hydrogen content and some adsorptive properties of charcoals prepared under carefully controlled conditions.

Notes on the Effect of Solar Disturbances on Transatlantic Radio Transmission,[18] by Clifford N. Anderson. In 1923 when the relation between abnormal long-wave radio transmission and solar disturbances was first noted, the outstanding abnormality was the great decrease in night time signal field strength accompanying storms in the earth's magnetic field. There was a slight increase in daylight signal field but this was distinctly secondary to the effect upon night field. Previous to 1927, data on signal fields were limited to one set of measurements a week, and although daylight signal field strengths were higher during periods of increased magnetic activity, it was somewhat difficult to determine the effect of individual storms. The present notes show the effects of individual storms of 60-kc transatlantic radio transmission and also give some indication as to their effect on short-wave radio transmission.

[18] Proceedings of the Institute of Radio Engineers, September, 1929.

Notes on Recent Occurrences

FOURTH INTERNATIONAL CONGRESS OF ACCOUNTANTS ADDRESSED BY SEVERAL A. T. & T. MEN

THE Fourth International Congress of Accountants met in New York, September 9 to 14, 1929. The meeting was attended by prominent accountants of many countries. One of the United States' speakers was J. F. Behan, Assistant Comptroller of the American Telephone and Telegraph Company, whose topic was "Educational Activity in Accounting and Statistical Work." A. B. Crunden, Assistant Comptroller, and D. R. Belcher, Assistant Chief Statistician of the A. T. & T. Co., presented a paper on the straight line depreciation accounting practice of telephone companies in the United States, which was printed in the October issue of the Bell Telephone Quarterly.

The technique and advantages of budgetary practice were discussed by a number of prominent delegates, including C. A. Heiss, Comptroller of the A. T. & T. Co., who described the Bell System budget plan at some length. S. L. Andrew, Chief Statistician of the A. T. & T. Co., presented a paper pointing out the relation of statistics to accounting in modern business organizations.

An interesting feature of the Congress was an exhibit by the Long Lines Department of the A. T. & T. Co., which consisted of displays featuring out of town telephone service, telephone typewriter service and telephotographs.

PERSONNEL CONFERENCE

THE Personnel Conference at Washington, D. C., October 23 to 30 was the fifteenth meeting of the Personnel Representatives of the System since they were first brought together in New York almost exactly ten years ago.

Representatives of each of the Associated Telephone Companies, the Western Electric Company, the Bell Telephone Laboratories and several sections of the General Staff of the American Telephone and Telegraph Company brought the daily attendance up to about sixty members.

In opening the Conference E. K. Hall, Vice President of the A. T. & T. Co., briefly reviewed the several previous meetings of the group indicating some of the major developments in personnel plans and referring to some of the outstanding milestones which have marked the progressive improvement of the personnel relations in the Bell System during the past decade. Bancroft Gherardi, Vice President of the A. T. & T. Co., outlined some of the operating results and trends of the business. S. L. Andrew, Chief Statistician of the A. T. & T. Co., followed him with a paper on "The Influence of Money and Banking on Recent Economic Developments." These three talks together with comments by K. W. Waterson, Assistant Vice President of the A. T. & T. Co., on wage schedules and trends, a paper by Dr. L. D. Bristol, Health Director of the Bell System, on "Health Promotion in the Bell System," a brief description of the Nutrition Course experiment and Mr. Hall's informal talk in connection with the closing of the conference were the outstanding individual contributions to the program.

All but two of the Conference sessions were devoted to the presentation and discussion of reports prepared by Committees of Associated Company Personnel Men covering all phases of the work with which this group is primarily concerned. These reports include suggestions for the future as well as conclusions derived from the experiences of the past. In the aggregate they represent the most comprehensive summary that has ever been made of the personnel plans and activities of the System.

The subjects of the reports were as follows:

Getting Information to Employees
The Conference Process and Some of Its Possibilities

Relations of Management to Employee Representation
Management's Relations to Thrift Plans and Activities
Sources and Selection of Potential Leadership
Discovery and Development of Leadership Material
Benefit Plan Administration
Medical Department Administration and Practices

One of the Conference sessions was largely given over to a general discussion of important plans and activities which are still in process of development and have not yet been officially announced and a number of miscellaneous subjects proposed for discussion by various members of the group.

H. W. Bang, Vice President of the Illinois Bell Telephone Company, was Chairman of the Conference Committee in charge of general arrangements.

DR. JEWETT VICE CHAIRMAN OF U. S. DELEGATION TO WORLD ENGINEERING CONGRESS AT TOKYO

VICE-PRESIDENT JEWETT was named by President Hoover a member of the delegation of seventeen to represent the United States at the World Engineering Congress meeting at Tokyo in October.

Dr. Jewett, in addition to being a member of the special delegation, was Vice Chairman of the American Committee. Vice Presidents Carty and Gherardi are also members of this Committee. Dr. Jewett presented a joint paper by Mr. Gherardi and himself.

The Congress was held under the auspices of the Kogakkai —the Engineering Society of Japan—and its object was to advance and diffuse knowledge by papers and discussions on scientific and engineering subjects and to promote international cooperation in the study and application of engineering science.

The party spent two days at Honolulu en route. An ex-

tensive program of excursions and inspection tours covering Japan, Chosen and Manchuria was also arranged.

Outstanding social functions were a Tea Party given by the Mikado, a Garden Party by Prince Chichibu, Patron of the Congress, and a Banquet given by the Prime Minister.

TRANSATLANTIC TELEPHONE SERVICE EXTENDED TO ALL AUSTRIA

TRANSATLANTIC telephone service was extended to all points in Austria on November 6.

The rate for a telephone conversation between New York City and these points is $51 for the first three minutes and $17 for each additional minute. Service is available throughout the 24 hours.

Service to the city of Vienna has been available for more than a year, that city having been connected to the transatlantic circuit on November 3, 1928. Austria has a population estimated at 6,785,000, served by approximately 220,000 telephones.

Calls to Austria are routed through London, as in the case of all others to the Continent. The circuit from London to Vienna is about 900 miles long.

CONFERENCE COVERING TOLL CABLE AND ASSOCIATED DESIGN PROBLEMS

IN accordance with an announcement in a previous issue of the Headquarters Bulletin, a Conference covering Toll Cable and Associated Design Problems was held recently at 195 Broadway. Due to the large number of Associated Company people who desired to attend this conference it was necessary to divide the conference into the two successive sessions. The first of these was held in the week of November 11, 1929, the second in the week of November 18, 1929. These sessions were attended by 85 Associated Company men interested in

the transmission design of the toll cable plant, and by representatives from the Bell Laboratories and the General Departments of the American Telephone and Telegraph Company. About sixty men attended each session of the conference.

At the beginning of the conference, W. H. Harrison, Plant Engineer of the A. T. & T. Co., reviewed the operating results and the trends of the toll business, giving a good idea of the growth of the toll plant and of the expected growth for the future. He called attention to the responsibility resting with those men who design this type of plant and to the importance of exercising careful judgment in the work looking towards the extension and betterment of toll service.

Papers presented at the conference covered the principal subjects involved in the engineering of toll cable plant. Important among these were:

General Toll Switching Plan and Terminal Repeater—Switching Pad Problems
Toll Cable and Loading Standardization
Toll Cable Systems
Program Transmission Systems
Short Haul Toll Problems

Other papers related to subjects closely allied with the transmission design of the toll plant, such as toll equipment matters, signaling systems, repeaters, noise and crosstalk considerations, toll transmission maintenance, and telegraph considerations.

The importance in connection with transmission design work of obtaining the views of other interested departments was generally emphasized and of much interest in this connection were papers by M. B. French, Traffic Engineer of the A. T. & T. Co., on Future Traffic Problems, by W. T. Anthony, Plant Extension Engineer of the A. T. & T. Co., on The Material Situation, and by J. N. Kirk, Outside Plant Engineer of the A. T. & T. Co., on Toll Cable Construction and Maintenance. O. B. Blackwell, Transmission Development Engineer of the A. T.

& T. Co., presented an interesting paper on development considerations. Interesting papers also were presented by Associated Company men on carrier and open wire engineering and on toll circuit layout considerations. Brief talks of especial interest were given by Vice President Gherardi and J. J. Pilliod, Engineer, Long Lines Department, A. T. & T. Co.

Among the interesting features of the conference were trips to the Kearney works of the Western Electric Company and to the Bell Telephone Laboratories, where the members of the conference saw many things of interest in connection with their work. A demonstration at 195 Broadway, of programs over 2,200 miles of the new B-22 cable program transmission system provided an added feature.

TOLL RATES CUT AGAIN JANUARY 1

A NEW schedule of toll telephone rates became effective January 1st representing an annual saving to the public of more than $5,000,000.

Approximately 45,000,000 calls a year, mostly interstate, are affected by the reductions. On most station-to-station calls during the day period to points approximately 60 to 300 miles distant there is a reduction of 10 cents. The new schedule also reduces the overtime charge on person-to-person messages of more than ten chargeable minutes on nearly all hauls. In addition there are reductions in report charges ranging from 5 cents to 40 cents and affecting the schedule at hauls generally from 100 to 2,200 miles.

This is the fourth decrease in toll and long distance rates that the American Telephone and Telegraph Company and its associated companies in the Bell System have made in less than three and a half years, according to the System's continuing policy of furnishing the best possible service at the least cost consistent with financial safety. The last previous reduction

went into effect February 1, 1929, amounting to a saving to the users of telephone service of about $5,000,000 annually.

The striking increase in the use of the telephone for long distance calls that was so noticeable in 1928 has continued throughout the present year, reflecting the public's reaction to the steadily increasing speed of service and the steadily decreasing cost of the service. At the present time about 95 percent of all toll and long distance calls are handled while the calling party remains at the telephone as compared with 90 percent at the beginning of 1928 and 70 percent in 1925. New telephone installations throughout the System at the rate of 3,000 per day also indicate a constantly growing recognition of the convenience and economy of the telephone for out-of-town communication as well as for local service.

SHIP–TO–SHORE TELEPHONE SERVICE OPENED TO THE *LEVIATHAN*

ON December 8 commercial ship-to-shore telephone service connecting the telephones of the Bell System with the S. S. *Leviathan* was formally opened with an exchange of greetings between President Walter S. Gifford and others ashore, and Commodore Cunningham, in command of the *Leviathan,* 200 miles out at sea. In addition to Bell System executives and newspaper representatives, the opening ceremonies were attended by members of the Federal Radio Commission, officers of the U. S. Navy, and officials of the United States Lines, which operate the *Leviathan.*

The new service is available to the public for direct telephone connection with the S. S. *Leviathan* on all outgoing and incoming trips while the ship is within range, at charges varying from $21 to $33 for the first three minutes of service, depending upon the geographical zone in which the shore telephone is located. The charges for each additional minute vary from $7 to $11 upon a like basis.

Addressing the guests assembled at the headquarters of the American Telephone and Telegraph Company just before the exchange of greetings with Commodore Cunningham aboard the *Leviathan,* President Gifford said:

"We are meeting to inaugurate telephone service with ships at sea. This service begins today between the telephones in the United States and those on the *Leviathan.* Today we are reaching one ship. The service is new. But like all such developments in telephony, we expect that it will spread from one ship to another until within a few years what is now a novelty will be a commonplace, and people will think no more of calling a friend on any ship at sea and anywhere at sea that the ship may be than they now do of telephoning from one city to another.

"Transoceanic telephone service was only opened a little less than three years ago. All of us have been surprised at the extent to which it has been used. I think we will be equally surprised with the development of this new ship-to-shore service. The transoceanic service was opened with one long wave channel. There are now in use this long wave channel and three short wave channels. A telephone cable to supplement these channels will be operating in 1932. And early next year we shall start a radio telephone service to South America.

"In the telephone service we open today between the *Leviathan* and the Bell System, calls from telephones on land to the *Leviathan* will go through the transmitting station at Deal Beach, N. J. Calls from the *Leviathan* to telephones on land will come through the new receiving station at Forked River, N. J. On shore the receiving station and the transmitting station are separated. Not only that but they have ample room for directional antenna. On the ship, of course, both receiving and transmitting have to be done from the same point and the available space for antenna is limited. Moreover, the radio telegraph traffic on a ship like the *Leviathan* is

practically continuous, and a great deal of technical work had to be done to avoid interference from this telegraph traffic as well as interference from other electrical apparatus used on the ship.

"I mention these things because I want to point out the very fundamental difference between making a demonstration and providing a service. A demonstration of the possibility of telephoning to ships at sea was made way back in the war times as a part of the preparedness investigations conducted between engineers of the Bell System and the Navy Department. But a demonstration under conditions favorably arranged and a service to work under all kinds of natural conditions without interference with the other activities aboard ship—those are two very different matters.

"The success in working out ship-to-shore service on a commercial basis is a notable addition to the long list of achievements of the telephone engineers."

TALK FROM AIRPLANE OVER NEW YORK TO *LEVIATHAN* AT SEA

ON December 22 telephone connection between an airplane in flight, 3500 feet in the air over New York Bay, and the regular commercial ship-to-shore telephone service to the S. S. *Leviathan* 700 miles out in the Atlantic Ocean, was demonstrated experimentally. Newspaper reporters, the pilot and a radio engineer made up the party in the Bell Telephone Laboratories airplane, from which conversation was transmitted to the Bell Laboratories radio station at Whippany, New Jersey, thence by wire through New York to the radio transmitting station at Deal Beach, New Jersey, and from there to the *Leviathan*. Commodore Cunningham and others aboard the ship conversed with those in the airplane for twenty minutes. Their voices came through the receiving station at Forked River, N. J., thence by wire *via* the ship-to-shore control room in New York to Whippany. From there they were transmitted by radio to the airplane in flight, where they were clearly heard.